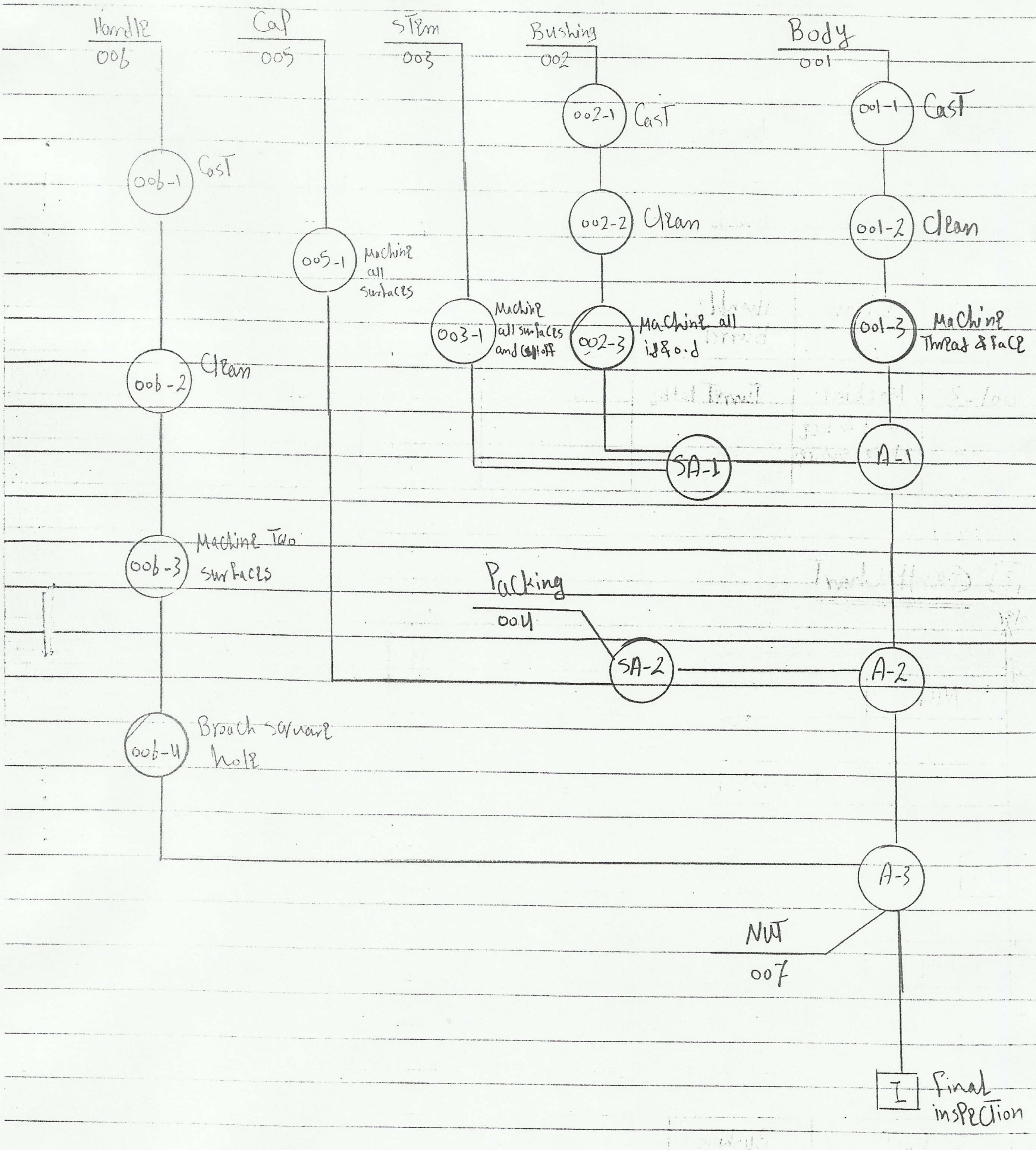
ج ١ —

Solution of sheet (2)
خاص بالفريق

①

2.9 ① Operation Process Chart



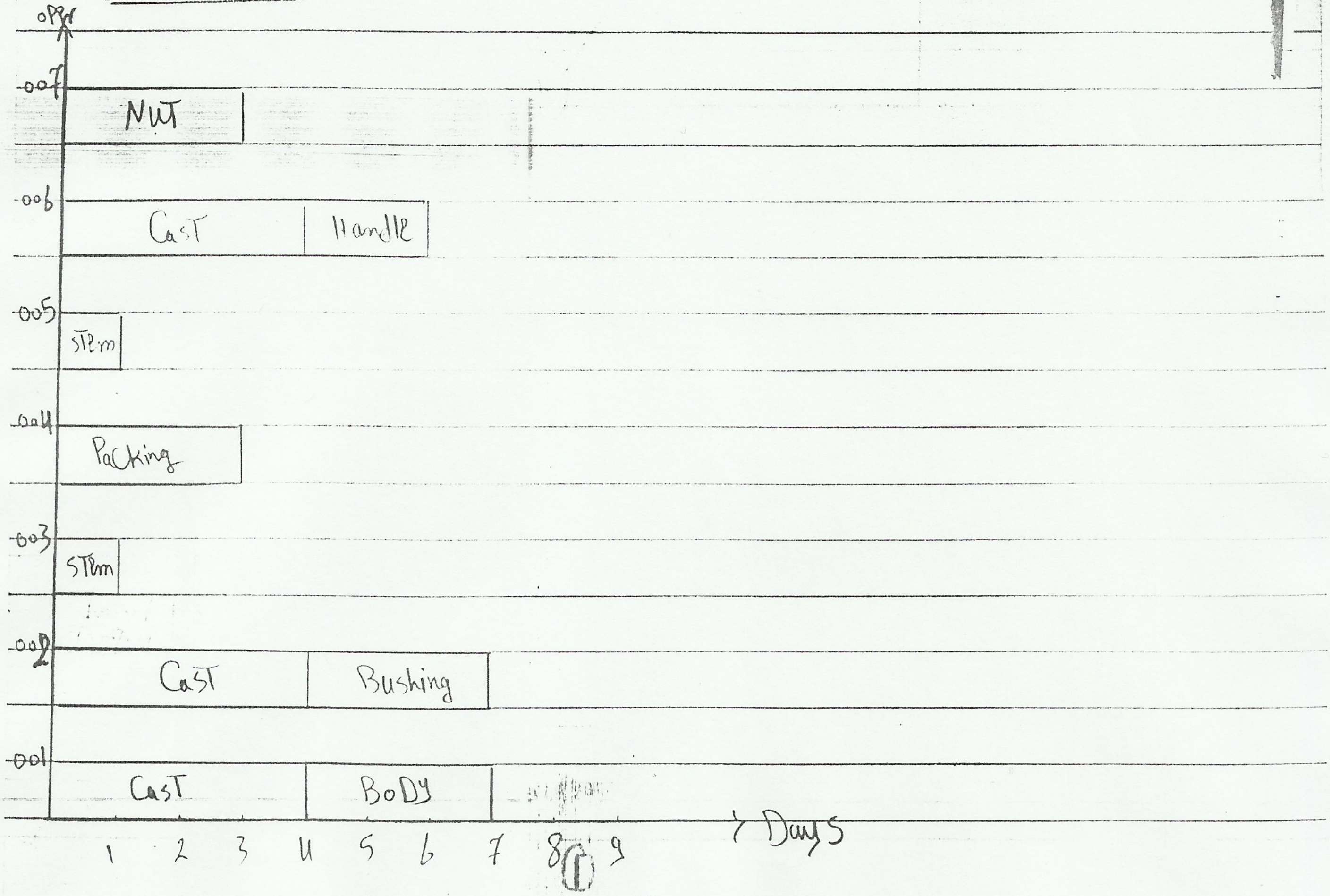
[2] Route sheets

Company: El-Sweedy | Part. Name: Body | Prepared By: ISLAM ADAM

Product: GATE-Valve | Part. No: 001 | Date: 28/12/2012

Oper. No	Oper description	Machines	Tool	Set up (hr)	Std. Time (hr)	Materials
001-1	Cast	Bench mold			0.025	Cast Bronze
001-2	Clean	Tumble Barrel			0.006	
001-3	Machine Thread & face three surfaces	Turret lathe			0.014	

[3] Gantt Chart



[3] no. of equipment → To Produce 500 gate valves Per hr

$$F_{\text{Bench mold}} = \frac{S * Q}{H}$$

$$= \frac{3.45 * 500}{60} = 28.75 = 29 \ \text{MC / Min} = 1 \ \text{MC / HR}$$

$$F_{\text{Tumble barrel}} = \frac{S * Q}{H}$$

$$= \frac{0.9 * 500}{60} = 7.5 = 8 \ \text{MC / Min} = 1 \ \text{MC / HR}$$

$$F_{\text{Turret Lathe}} = \frac{S * Q}{H}$$

$$= \frac{4.15 * 500}{60} = 35 \ \text{MC / Min} = 1 \ \text{MC / HR}$$

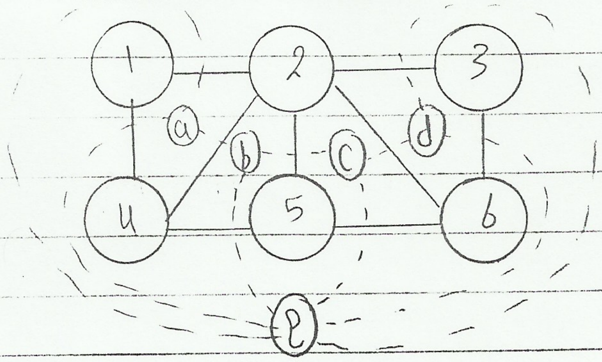
$$F_{\text{Automatic screw MC}} = \frac{S * Q}{H}$$

$$= \frac{0.42 * 500}{60} = 1 \ \text{MC / HR}$$

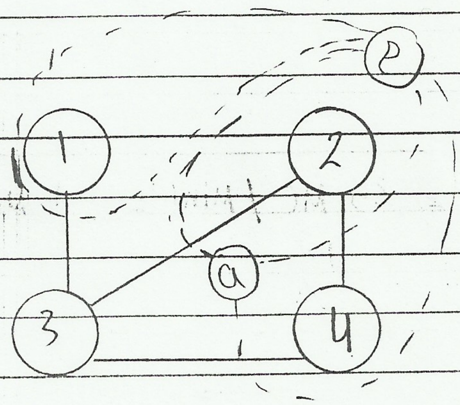
$$F_{\text{Broach}} = \frac{S * Q}{H}$$

$$= \frac{0.75 * 500}{60} = 1 \ \text{MC / hr}$$

2.11



2 is exterior



3 is exterior

2.12 Are two graph equivalent? Justify your answer?

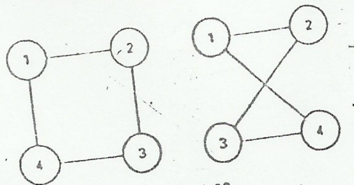
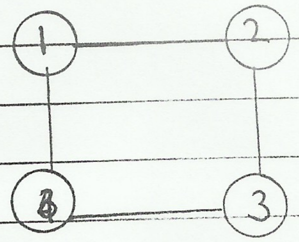
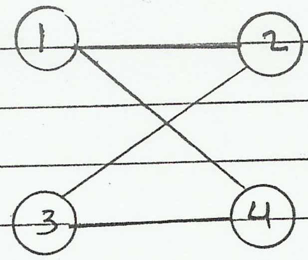
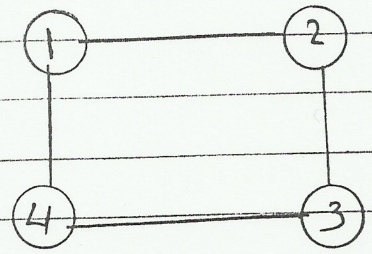


Figure P2.12







two graphs are equivalent.

5

4

2.15. Is the graph shown in Figure P2.15 planar? If so, construct the dual graph and the corresponding block layout.

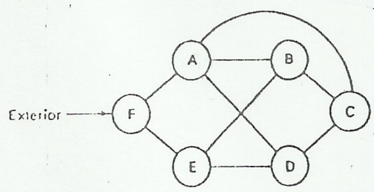
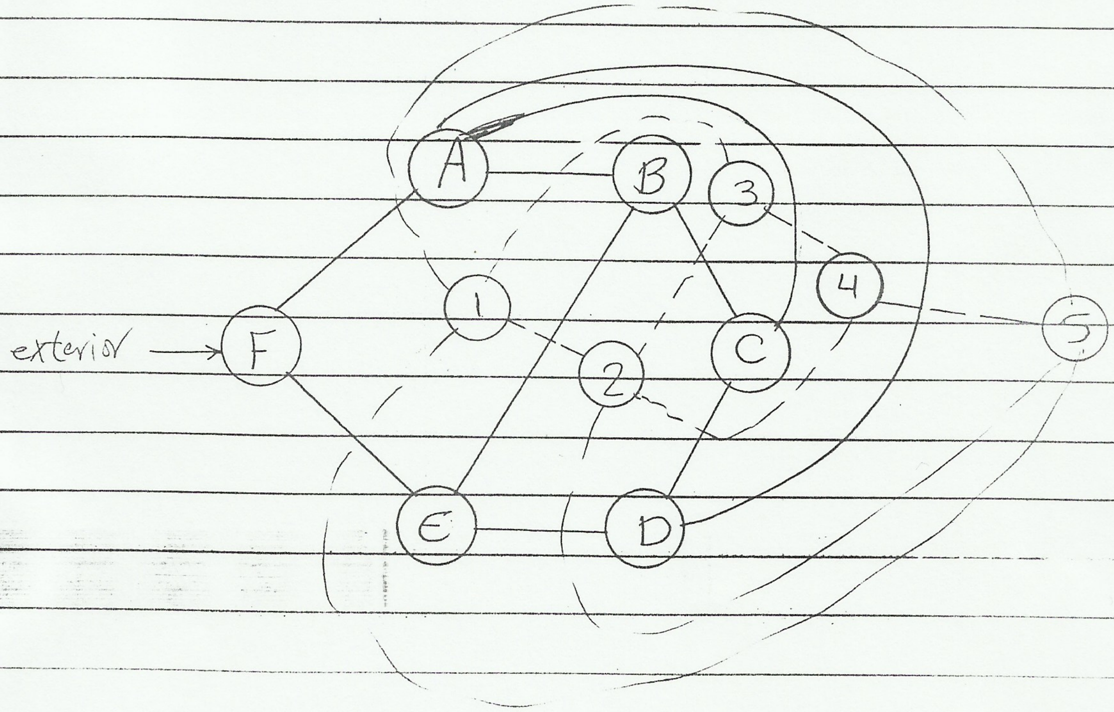


Figure P2.15



A, B, C, D, E primal vertices
1, 2, 3, 4, 5 dual vertices
F exterior

10 7

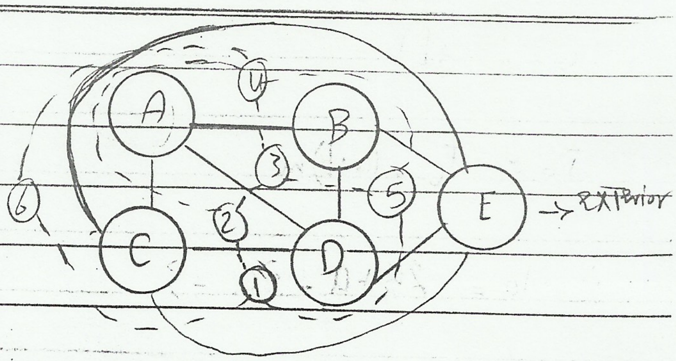
$\boxed{2.13}$

First shape is nonplannar Because There aren't any intersection

second shape is non-Plannar Because The intersection

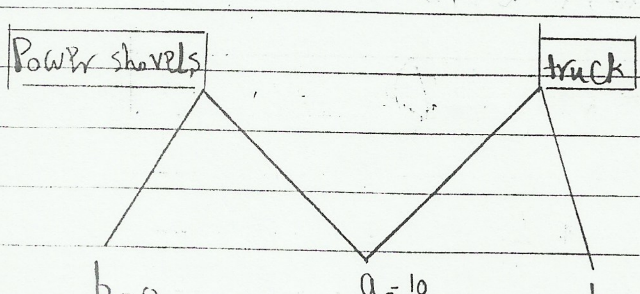
$\boxed{2.14}$

A ⇒ AB, AD	Assumption
E ⇒ AC, BD, BC	
I ⇒ CD , U ⇒ AE, BE, CE, DE	



① Assumption an (REL) Diagram
② Solve it By (SLP) method
③ Solve it By graph method

$\boxed{2.26}$



$b = 0$ $a = 10$ $t = 15 + 2 + 12 = 29$

$$\acute{n} = \frac{a+t}{a+b} = \frac{39}{10} = 3.9 = 4$$

$C_o = 125$ & $C_m = 75$ $E = \frac{C_o}{C_m} = \frac{5}{3}$

$$\Phi = \frac{E+n}{E+n+1} * \frac{\acute{n}}{n} = \frac{\frac{5}{3}+3}{\frac{5}{3}+4} * \frac{3.9}{3} = 1.07 \simeq 2 \text{ M/Cs}$$

$\boxed{2.28}$

$I_o = 10$ minutes $\Rightarrow 3$ M/Cs

$t = 25$ Min , $b = 1$ min

$\therefore T_C = (a+t)$

$\because I_o = T_C - (a+b)m$

$\therefore 10 = 25 + a - 3a - 3$

$\therefore 2a = 12$ $\boxed{\therefore a = 6 \text{ Min}}$

$\therefore n' = \frac{a+t}{a+b} = \frac{31}{7} = 4.4 \simeq 5$ M/Cs.

$\therefore T_C = (C_o + m C_m)(a+b)$

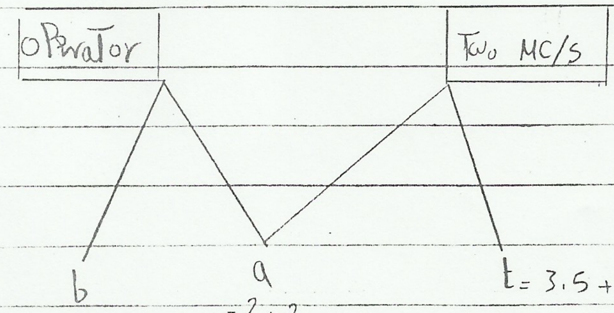
$= (8 + 3 * 25)(7) = $ \$ 1141

$\therefore \phi = \frac{\epsilon + n}{\epsilon + (n+1)} * \frac{n'}{n}$

$= \frac{0.32 + 4}{0.32 + 5} \times \frac{4.8}{5} = 0.77$

$\because \phi < 1$ $\therefore m' = n = 4$ MC/s

2.29



$t = 3.5 + 3.5 = 7$ Min

$b = 0.8 + 0.2 + 0.8 + 0.2 = 2$ Min

$a = 2 + 2 = 4$ Min

$$n' = \frac{a+t}{a+b} = \frac{11}{6} = 1.8 \approx \begin{cases} 1 \text{ MC/s} \\ 2 \text{ MC/s} \end{cases}$$

$\therefore$ Total Cost $= (C_o + m C_m)\left(\frac{a+t}{m}\right)$

$= (15 + 2 \times 30)(11) = 825$

$\therefore I_o = (a+t) - (a+b)m$

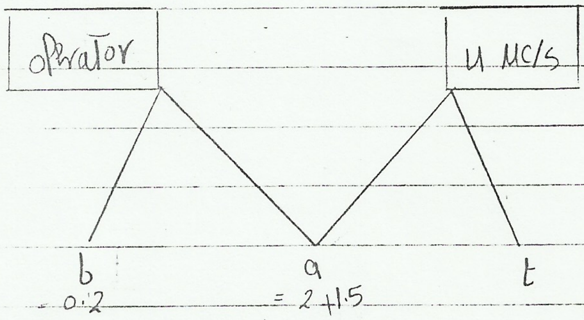
$\therefore I_o = 11 - 6 \times 1 = 5$

if $n = 2$

$\therefore I_o = 11 - 12 = -1$

$\therefore$ optimum MCs $= 1$

2.31



$b = 0.2 + 0.2 + 0.1 + 0.2 + 0.2 + 0.1 + 0.2 + 0.2 + 0.1 + 0.2 + 0.2 + 0.1 = 2$ Min

$a = 2 + 1.5 + 2 + 1.5 + 2 + 1.5 + 2 + 1.5 = 14$ Min

$\therefore I_{m=10} = (a+b)m - (a+t) \Rightarrow 10 = (16 \times 4) - 14 - t$

$\boxed{\therefore t = 40 \text{ Min}}$

10

$$n' = \frac{a+t}{a+b} = \frac{54}{16} = 3.3 \simeq 4 \text{ MC/s}$$

$$\phi = \frac{0.5+3}{0.5+4} * \frac{3.3}{3} = 0.85$$

$\phi < 1 \quad \therefore m' = n = 3$ m/Cs

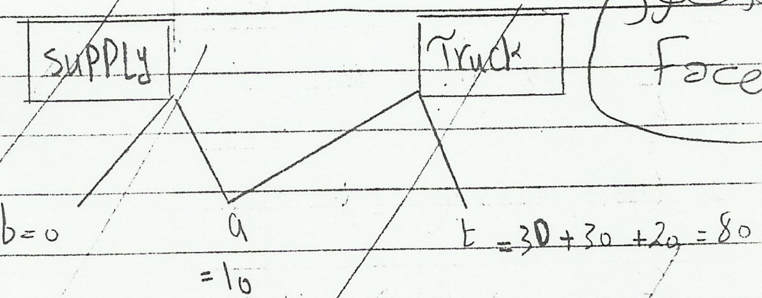
(b) $m = 2$ MC/S $< n'$

$$\therefore T_C = (C_o + mC_m)(a+t)/m$$

$$= (15 + 2*30)\left(\frac{54}{2}\right) = \$\ 2025$$

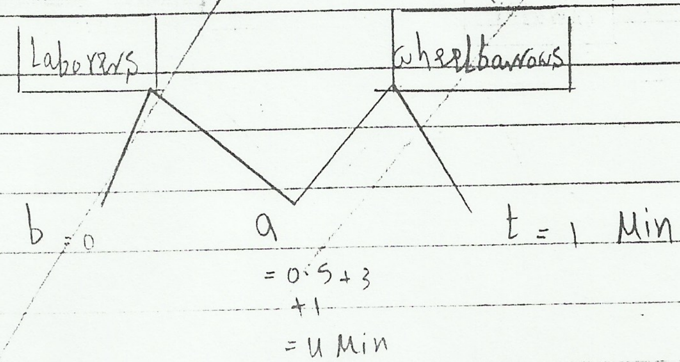
$\boxed{2.32}$

حل الدكتور
Face ع



??

$$\therefore n' = \frac{a+t}{a+b} = \frac{90}{10} = 9 \text{ MC/s}$$



$$\therefore n' = \frac{a+t}{a+b} = \frac{5}{4} = 1.25 \simeq 2 \text{ Laborer}$$

تكملة رقم (3b)

Case 2 $\Rightarrow$ (5, 6)

$TC = TC\,(m=5) + TC\,(m=6)$

$= \left[(C_o + m\,C_m)(a+b)\right] + \left[(C_o + m\,C_m)(a+b)\right]$

$= \left[(15 + 5 \times 50)\left(\frac{9.5}{60}\right)\right] + \left[(15 + 6 \times 50)\left(\frac{9.5}{60}\right)\right]$

$= \$\ 91.833$

Case 3 $\Rightarrow$ (4, 4, 3)

$TC = 2\left[TC\,(m=4)\right] + \left[TC\ m=3\right]$

$= 2\left[(15 + 4 \times 15)\left(\frac{9.5}{60}\right)\right]\left[(15 + 3 \times 50)\left(\frac{9.5}{60}\right)\right]$

$= \$\ 49.875$

$\therefore$ select Case (3)

(C) $\phi = 1 \quad \Rightarrow \quad \epsilon = ??$

$\therefore 1 = \dfrac{\epsilon + n}{\epsilon + n + 1} \times \dfrac{n'}{n}$

$\therefore 1 = \dfrac{\epsilon + 2}{\epsilon + 3} \times \dfrac{2.9}{2}$

$\therefore \dfrac{20}{29} = \dfrac{\epsilon + 2}{\epsilon + 3} \quad \Rightarrow \quad 20\epsilon + 60 = 29\epsilon + 58$

$\therefore \epsilon = \dfrac{2}{9} = 0.222$

+2

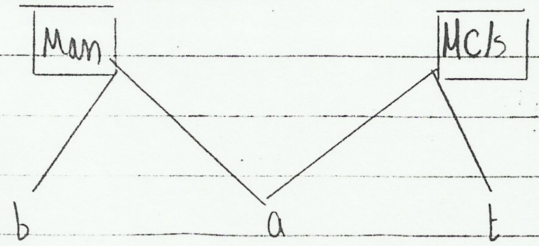
(b) $I_m = (a+b)m - (a+t)$

$= (4 * 2) - 5 = 3$ Min

(c) $T_c = (a+b)m$

$= 4 * 2 = 8$ times

$\boxed{2.36}$



b $= 0.25 + 1.25 = 1.5$ Min

a $= 4 + 4 = 8$ Min

t $= 20$ Min

(a) $n' = \frac{a+t}{a+b} = 2.9 \simeq 3$ M/Cs

(b) Case 1 $\Rightarrow (3, 3, 3, 2)$

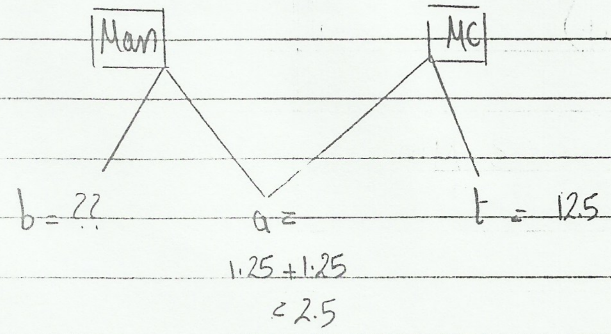
$$T_c = 3\left[T_c\,(m=3)\right] + \left[T_c\,(m=2)\right]$$

$$= 3\left[(C_o + mC_m)(a+b)\right] + \left[(C_o + mC_m)\left(\frac{a+t}{m}\right)\right]$$

$$= 3\left[(15 + 3 * 50)\left(\frac{9.5}{60}\right)\right] + \left[(15 + 2 * 50)\left(\frac{28}{60}\right)\right]$$

$$= \$\ 132.04$$

$\boxed{2.38}$



$$n' = \frac{a+t}{a+b}$$

$$\text{Utilization} = \frac{\text{Cycle time} - \text{idle time}}{\text{Cycle time}}$$

$$= \frac{\cancel{(a+t)} - [\cancel{(a+t)} - (a+b)m]}{(a+t)}$$

$$\therefore 0.8 = \frac{(a+b)m}{(a+t)}$$

$$\therefore 0.8 = \frac{(2.5+b)\,4}{15}$$

$\therefore b = 0.5$ Min

ⓐ $\therefore n' = \frac{15}{3} = 5$ M/Cs

ⓑ

n'

$4 < n' < 5$ $\quad\quad$ $5 < n' < 6$

$$\phi = \frac{\frac{C_o}{C_m} + n}{\frac{C_o}{C_m} + n + 1} * \frac{n'}{n} > 1 \quad\quad \frac{0.25+5}{0.25+6} * \frac{n'}{5} < 1$$

$$\frac{0.25+4}{0.25+5} * \frac{n'}{4} > 1 \quad\quad \therefore n' < 5.95$$

$\therefore n' > 4.94$

$\frac{15}{2.5+b} > 4.94$ $\qquad$ $\frac{15}{2.5+b} < 5.95$

$\therefore 4.94b + 12.35 < 15$ $\qquad$ $14.875 + 5.95b > 15$

$\therefore b < 0.54$ $\qquad$ $\therefore b > 0.02$

$\therefore$ Range of $b \Rightarrow 0.02 \leq b \leq 0.54$

(C) 18 M/C

Case 1 $\Rightarrow$ 5, 5, 5, 3

$$\text{Total Cost} = 3\,T_c(n=5) + T_c(n=3)$$

$$= 3\left[(C_o + mC_m)\left(\frac{a+t}{m}\right)\right] + \left[(C_o + mC_m)\left(\frac{a+t}{m}\right)\right]$$

$$= 3\left[(10+200)\left(\frac{15}{60\times 5}\right)\right] + \left[(10+120)\left(\frac{15}{60\times 3}\right)\right]$$

$$= \$\,41.8$$

Case 2 $\Rightarrow$ 6, 6, 6

$$\text{Total Cost} = 3\,T_c(n=6)$$

$$= 3\left[(C_o + mC_m)(a+b)\right]$$

$$= 3\left[(10+240)\left(\frac{3}{60}\right)\right] = \$\,37.5$$

$\therefore$ Select Case 2

15

$\boxed{2.39}$

$m = 3$ M/Cs Utilization $= 0.78$ $a = 8$ Min $b = 5$ min

$C_o = 10\$$ $C_m = \$12$

$$\text{utilization} = \frac{\text{cycle time} - \text{idle time}}{\text{cycle time}}$$

$$= \frac{\cancel{(a+t)} - \left[\cancel{(a+t)} - (a+b)m\right]}{a+t}$$

$$\therefore 0.78 = \frac{(a+b)m}{a+t}$$

$$\therefore 0.78 = \frac{13 * 3}{8+t} \qquad \therefore 6.24 + 0.78t = 39$$

$\therefore t = 5.25$

$$\therefore n' = \frac{a+t}{a+b} = 1.01 \sim 2 \text{ M/Cs}$$

$$\Phi = \frac{\frac{C_o}{C_m} + n}{\frac{C_o}{C_m} + n + 1} * \frac{n'}{n}$$

$= 0.65$

$\therefore m = n = 1$ M/Cs

ⓐ $$T_C = (C_o + mC_m)\left(\frac{a+t}{m}\right)$$

$$= (10 + 3 \times 12)\left(\frac{13.25}{1}\right) = \$\ 609.5$$

n'

$1 < n' < 2$ $2 < n' < 3$

$$\Phi > 1 \qquad \frac{\frac{C_o}{C_m} + n}{\frac{C_o}{C_m} + n + 1} * \frac{n'}{n} > 1 \qquad\qquad \frac{\frac{5}{6} + 2}{\frac{5}{6} + 3} * \frac{n'}{2} < 1$$

$$\frac{\frac{5}{6} + 1}{\frac{5}{6} + 2} * \frac{n'}{1} > 1 \qquad\qquad \therefore n' < 2.7$$

$\therefore n' > 1.545$

$$\frac{a+t}{a+b} > 1.545$$

$$\frac{a+5.25}{a+5} > 1.545$$

$\therefore a+5.25 > 1.545a + 7.725$

$\therefore -0.545\,a > 2.475$

$\therefore a < -4.5$

$$\frac{a+t}{a+b} < 2.7$$

$$\frac{a+5.25}{a+8} < 2.7$$

$a+5.25 < 2.7a + 21.6$

$\therefore -1.7a < 16.35$

$\therefore a > -9.55$

NOTES :

تراجع بالأوراق

$\boxed{2.33}$

$m = 3$ MC $I_o = 10$ Min $t = 25$ Min $b = 1$ min

$C_o = \$4$ $C_m = \$6$

(a) $I_o = T_C - (a+b)m$

$\therefore 10 = (a+t) - am - bm$

$\therefore 10 = a + 25 - 3a - 3$

$\therefore 2a = 12$ $\therefore a = 6$ Min

$\therefore n' = \dfrac{a+t}{a+b} = \dfrac{31}{7} = 4.428 \simeq 5$ MC/s

$\dfrac{\frac{C_o}{C_m}+n}{\frac{C_o}{C_m}+n+1} * \dfrac{n'}{n}$

$= 0.9$

$\boxed{\therefore n = 4}$

(b) $T_C = (C_o + mC_m)\left(\dfrac{a+t}{m}\right)$

$= (4 + 4 \times 6)\left(\dfrac{31}{4}\right) = \$217$ Per hr

(c) Case 1 $\Rightarrow$ 3, 3, 3

$\therefore T_C = 3\left[T_C\ (n=3)\right]$

$= 3\left[(C_o + mC_m)\left(\dfrac{a+t}{m}\right)\right]$

$= 3\left[(4 + 3 * 6)\left(\dfrac{31}{3 * 60}\right)\right]$

$= \$11.36$

Case 2 ⇒ 4, 5

$$TC = \left[TC\,(n=4)\right] + \left[TC\,(n=5)\right]$$

$$= \left[(C_o + mC_m)\left(\frac{a+b}{m}\right)\right] + \left[(C_o + mC_m)(a+b)\right]$$

$$= \left[(4 + 4 \times 6)\left(\frac{31}{4 \times 60}\right)\right] + \left[(4 + 4 \times 6)\left(\frac{7}{60}\right)\right]$$

$$= \$\,6.88$$

∴ select Case $\boxed{2}$

2.40. The KLM Job Shop has requested that a new layout be designed for their operation in Alpharetta, Georgia. There are 12 departments involved. The department areas (in square feet) and activity relationships for the job shop are summarized in Figure P2.40. Design a block layout using the SLP approach.

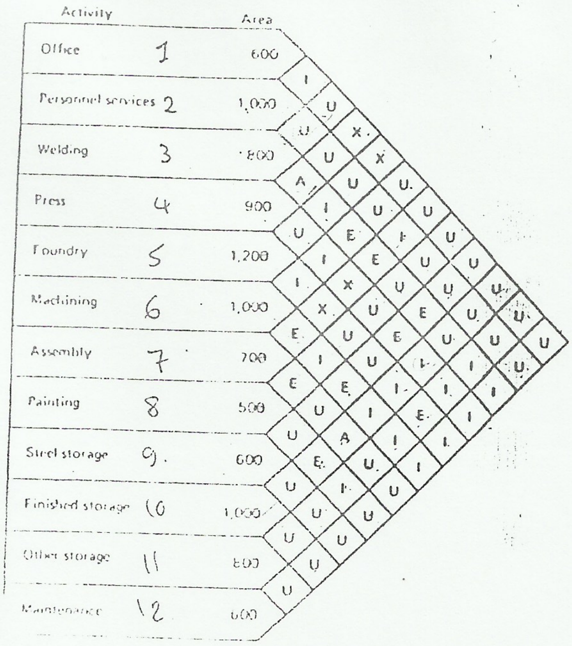


Figure P2.40

1- Solving by TCR:

	A (10,000)	E (1,000)	I (100)	O (10)	U (0)	X (-100,000)	TCR	Ranking
1			1		8	2	-199,900	12
2			1		10		100	8
3	1	3	3		4		13,300	1
4	1		4		4	2	-189,600	10
5		1	4		4	2	-198,600	11
6		3	6		2		3600	4
7	1	3	1		4	2	-186,900	9
8		2	2		7		2,200	6
9		3			8		3,000	5
10	1	1	3		6		11,300	2
11	1		4		6		10,400	3
12			4		7		400	7

6

80

m/c selected

m/c not selected	3	4	9	6	11	5	12	10	8	2	7	1
1	U	X	U	U	U	X	U	U	U	I	U	
2	U	U	U	U	U	U	U	U	U			
4	A											
5	I	U	U	I	E							
6	E	I	E									
7	E	X	U	U	U	X	U	A	E	I		
8	U	U	U	U	I	U	U	E				
9	E	E										
10	U	I	U	U	U	I	U					
11	I	I	U	U								
12	I	I	U	U	U	I						

7			11	5
2	10	4	3	12
1	8	9	6	

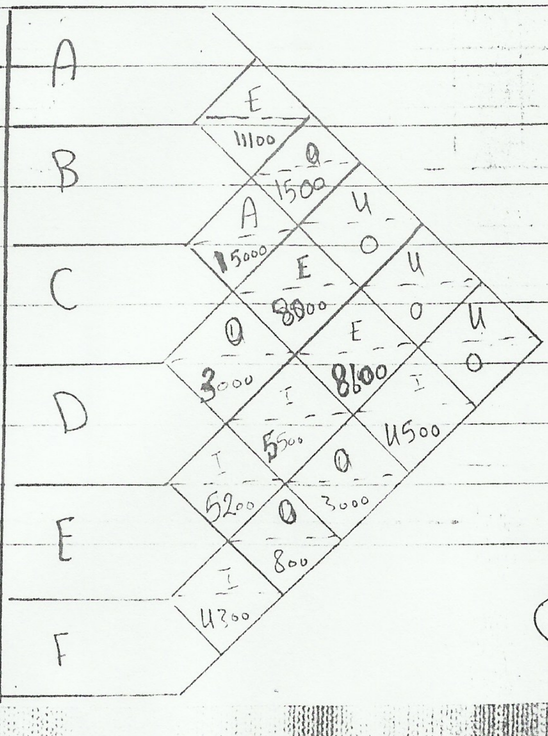
21 7

2.41

(a) From To Chart

From \ To	A	B	C	D	E	F
A		800+1000 +600+2000 +400+2000 +2500+1800 11100	1500 1500	0	0	0
B	0		800+1000 +2000+2000 +400+2500+800 9500	2000+2500 +1000 5500	1000+600 +2500 4100	2000+2500 4500
C	0	1000+2000 +2500 5500		800+400 +800 2000	2000+1500 3500	1000+2000 3000
D	0	2500 2500	1000 1000		800+400 +2000+1000 4200	800 800
E	0	2500+2000 4500	2000 2000	1000 1000		800+600 +1500+400 +1000 4300
F	0	0	0	0	0	

REL Chart



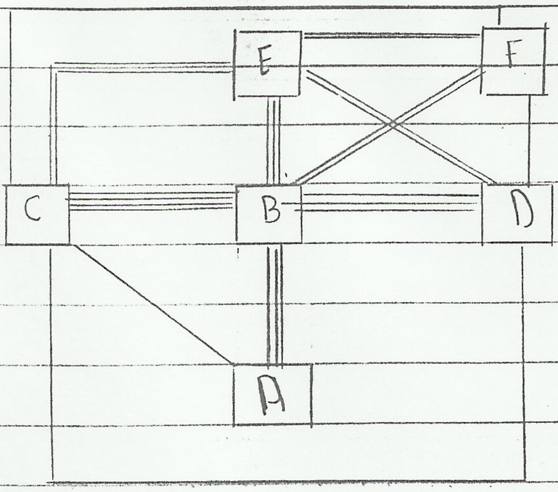
AC:

≣ A ⇒ BC

≡ E ⇒ AB, BD, BE

= I ⇒ BF, CE, DE, EF

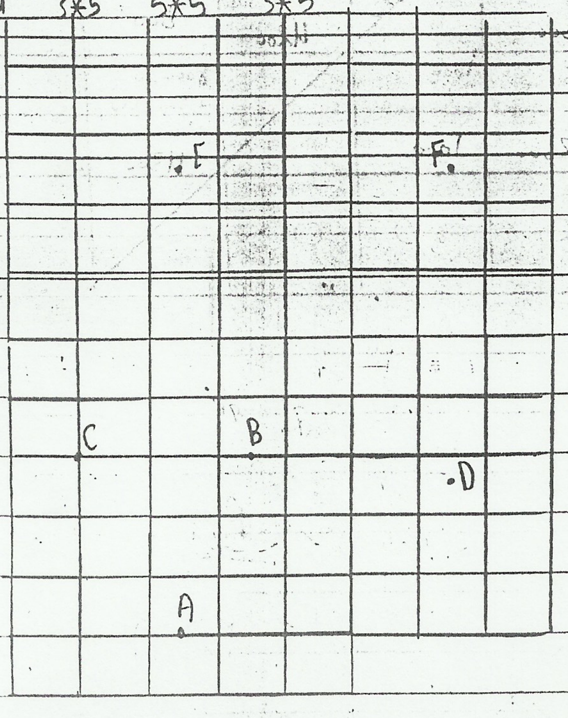
− O ⇒ AC, CD, CF, DF



* Space

Act	A	B	C	D	E	F
Area	10	12	8	15	25	15

2*5 2*6 2*4 3*5 5*5 3*5
3*4



ACT	BC	AB	BD	BE	BF	CE	DE	EF	AC	CD	DF	CF	Total
Quant	15000	11100	8000	8600	4500	5500	5200	4300	1500	3000	800	3000	
Space	2.5	4	3.5	5.5	7.5	6	9	4	4.5	6	6	10	

Total Flow = Total Quantity * Total DIST

2.14. The graph-based approach for constructing REL diagrams depends on having some department adjacent to the exterior. Suppose that it is not necessary for any department to be adjacent to the exterior. Propose some reasonable approaches that will allow use of the graph-based approach.

2.44. An auto-parts warehouse in Flyspeck, Texas, has requested that a new layout be designed for their main warehouse located in metropolitan Flyspeck. The warehouse has 10 major activity "centers." The current building has the dimensions of 150 ft × 225 ft. Other pertinent data are summarized in Figure P2.44. Using SLP, design a layout to be contained in the current building.

Activity		Area
Office	1	1,250
Counter	2	2,500
Parts bins	3	10,000
Muffler bins	4	2,500
Tailpipe racks	5	6,250
Paint room	6	3,000
Storage	7	5,000
Receiving	8	2,500
Lounge	9	500
Rest room	10	250

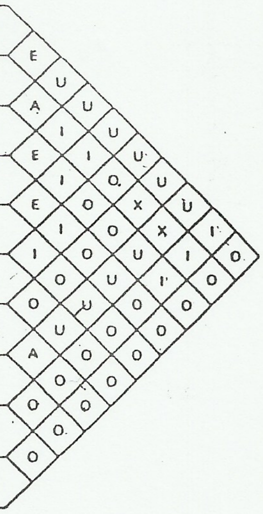


Figure P2.44

A: 3-2, 8-7

E: 1-2, 3-4, 5-4

I: 1-9, 9-2, 5-2, 4-2, 9-3, 5-3, 6-4, 6-5

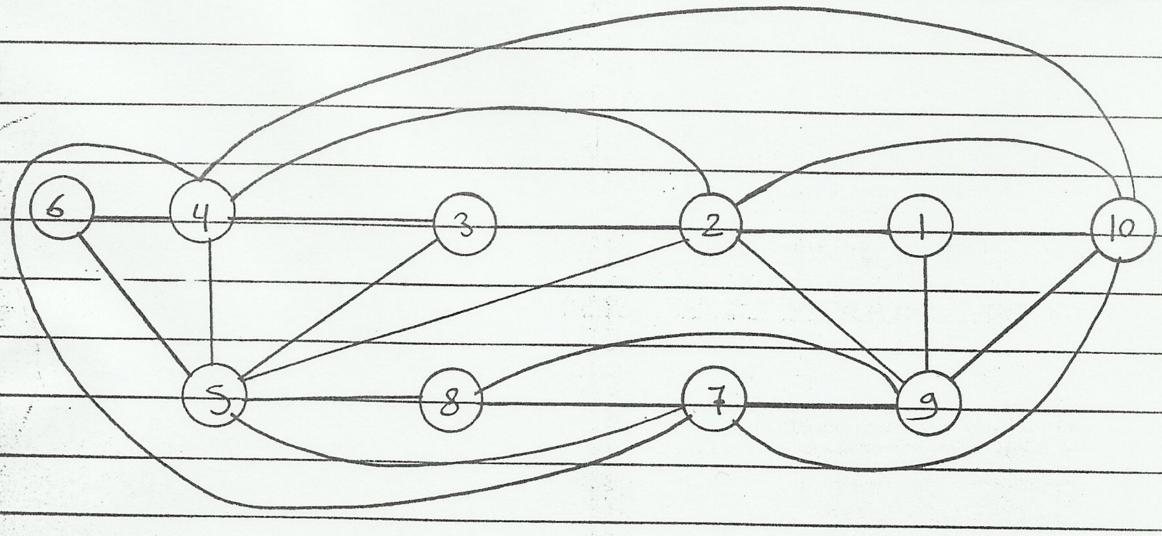
O: 10-1, 10-2, 6-2, 10-3, 7-3, 6-3, 10-4, 9-4, 7-4, 10-5, 9-5, 7-5, 10-6, 9-6, 7-6, 10-7, 9-7, 10-8, 9-8, 10-9

U: 8-1, 7-1, 6-1, 5-1, 4-1, 3-1, 8-3, 8-4, 8-5, 8-6

X: 8-2, 7-2

11 29

2.4-Solving by graph method:-



2.44:

≡ A: 3-2, 8-7.

≡ E: 1-2, 3-4, 5-4.

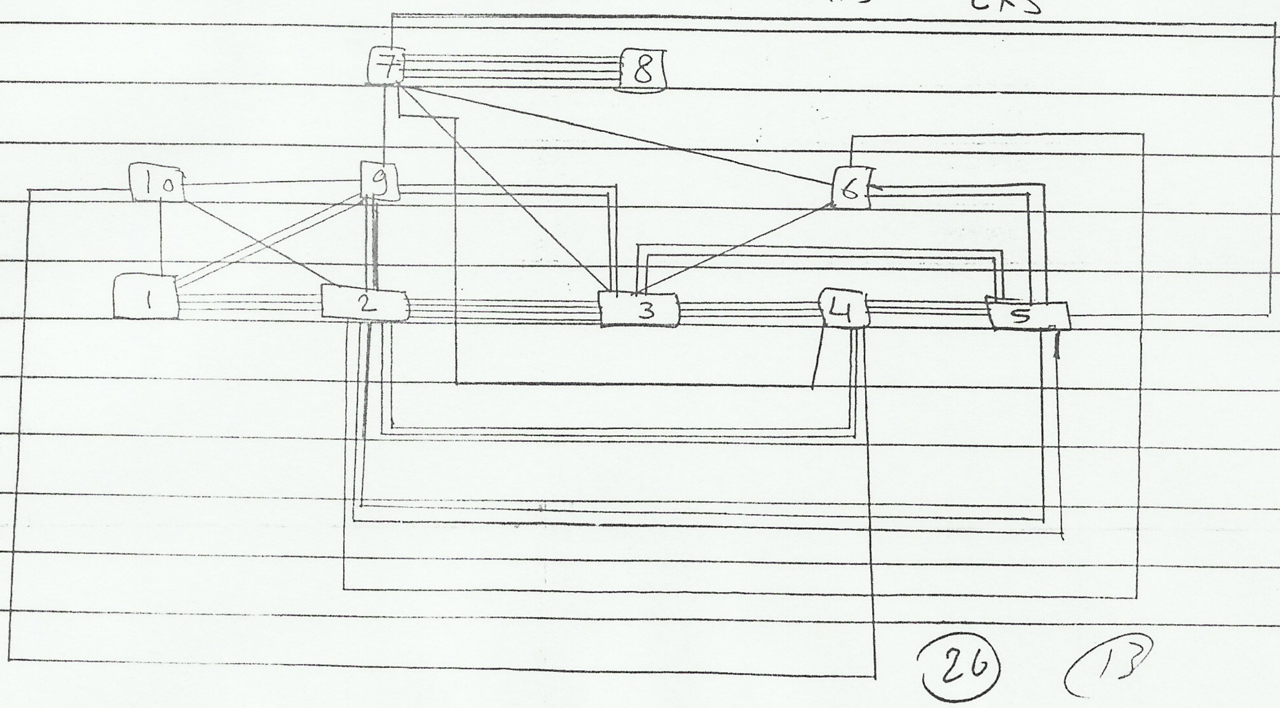
= I: 1-9, 9-2, 5-2, 4-2, 9-3, 5-3, 6-4, 6-5.

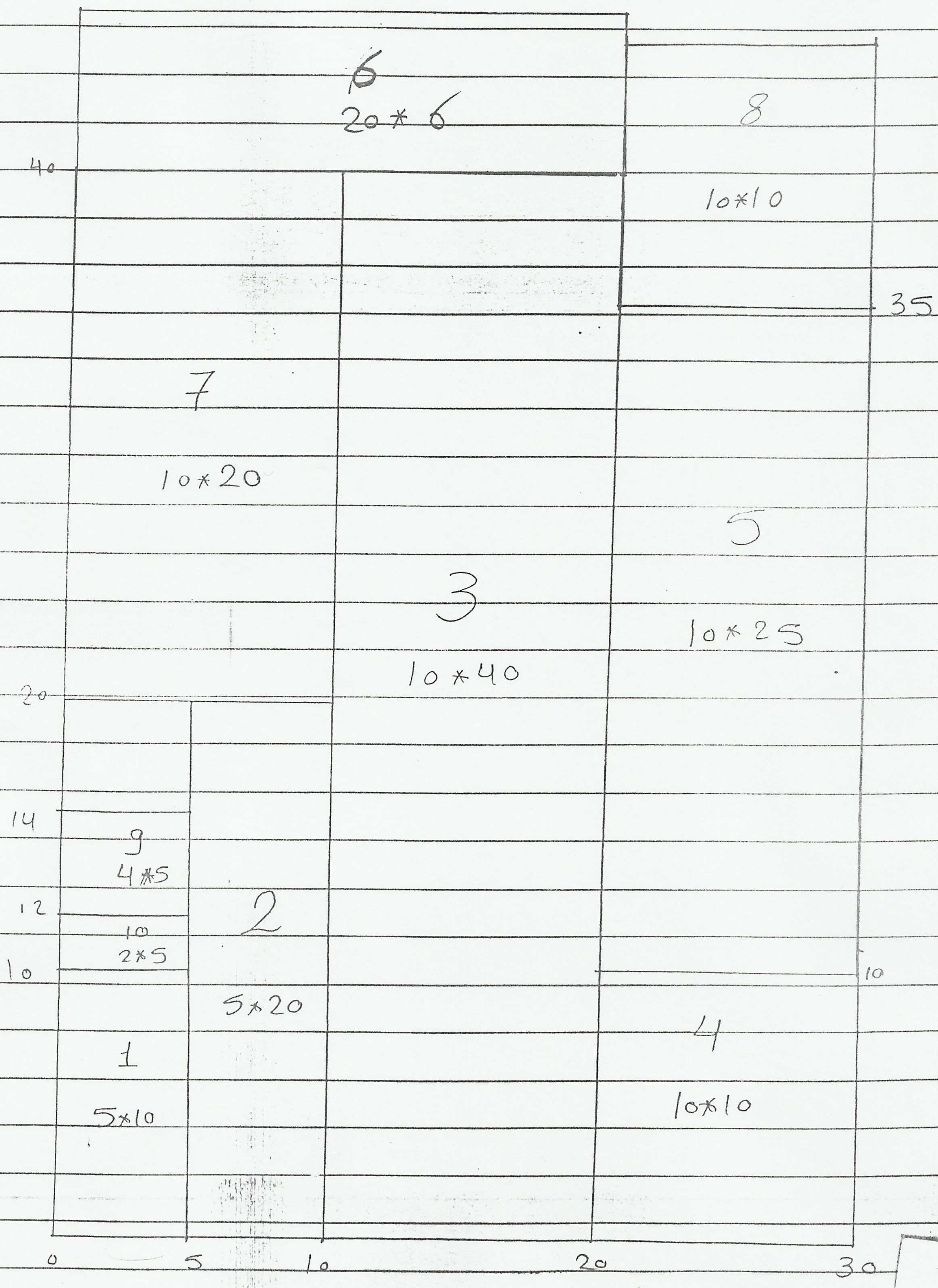
— O: 10-1, 10-2, 10-3, 6-2, 7-3, 6-3, 10-4, 9-4, 7-4, 10-5, 9-5, 7-5, 10-6, 9-6, 7-6, 10-7, 9-7, 10-8, 9-8, 10-9.

U: 8-1, 7-1, 6-1, 5-1, 4-1, 3-1, 8-3, 8-4, 8-5, 8-6.

x: 8-2, 7-2.

	1	2	3	4	5	6	7	8	9	10
	1250	2,500	10,000	2,500	6,250	3,000	5,000	2,500	500	250
25÷	50	100	400	100	250	120	200	100	20	10
	5x10	5x20	10x40	10x10	10x25	20x6	10x20	10x10	4x5	2x5




6
20*6
8
10*10
40
35
7
10*20
5
10*25
3
10*40
20
14
9
4*5
12
10
2*5
2
10
5*20
10
4
10*10
1
5*10
0
5
10
20
30